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POLICIES AND NON-FISCAL MEASURES FOR UPGRADING SME CLUSTERS - AN ASSESSMENT

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Executive summary

It is important that policy-makers focus on technological capability building as an essential element for the sustained competitiveness and productivity of SMEs in an increasingly technology-intensive global economy.

The neglect of domestic research and development activities has serious implications for the development of local technological capability. It hampers the ability to absorb and adapt foreign technologies, as well as the ability to obtain favourable technological transfer contracts. It will therefore constrain the ability of developing countries to technologically upgrade and undermine their international competitiveness.

The increasing knowledge-intensity of production in a globalizing world economy requires structural change which will have to be addressed by long-term policy measures. FDI can accelerate the process of technological upgrading, but it cannot substitute for local technological capabilities.

SMEs are obliged to seek partners and to leverage what few resources they can marshal through cooperative relationships with large firms. However, unless SMEs possess absorptive capacity, the extent of technology transfer through such links and the positive impacts of globalization will be minimal.

Since the bulk of the world's technology is in the hands of transnational corporations (TNCs), creating TNC-SME linkages in order to network SMEs into the global economy is a key element of innovation policy. Experience shows that in order to improve upon the impact of globalization on the SME sector and enhance the benefits from TNC-SME linkages, it will be necessary to build and strengthen networks between SMEs and local research institutions, including creating and strengthening North-South networks between researchers in order to facilitate knowledge creation in the South. A critical part of ensuring SME access to technology, information and new knowledge is the provision of financial support for the transfer and diffusion of technology.

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I. PREFACE

1. As mandated by the ninth session of the United Nations Conference on Trade and Development (UNCTAD IX), the Commission on Enterprise, Business Facilitation and Development deals with the areas defined in paragraphs 89(h)-(j) and 92-94 of "A Partnership for Growth and Development" (TD/378/Rev.1).

2. At its first session, the Commission on Enterprise, Business Facilitation and Development recognized the crucial role played by small and medium-sized enterprises (SMEs) in stimulating broad-based, equitable and sustainable development. It also acknowledged the changing global economic environment and the pressures faced by SMEs a result and it stressed the need to develop a coherent strategy for enterprise development, with a particular focus on SMEs.

3. The Commission recognized that further analytical work and policy research within UNCTAD was needed to develop enterprise development strategies, and it identified four areas for future work: (i) the respective roles of government and the private sector, including non-governmental organizations, and the interactions between them in creating a coherent policy framework and setting up effective support measures and structures for the development of SMEs and micro-enterprises, in particular those in least developed countries; (ii) the possible value as well as the ways and means of promoting and facilitating effective inter-firm cooperation, including clustering, networking and technology partnership, both domestically and internationally, as an instrument in fostering the development and competitiveness of enterprises; (iii) the development of innovation, entrepreneurial and technological capabilities as essential inputs for the development and growth of enterprises; and (iv) the short- and long-term impacts of macroeconomic reform and liberalization on the development and growth of enterprises, particularly SMEs.

4. In line with the above topics, the first expert meeting convened by the Commission discussed government and private sector roles and interactions in SME development. The second and third expert meetings convened by the Commission discussed inter-firm partnerships and SME clustering and networking respectively. The policy recommendations from these last two expert meetings were discussed at the third session of the Commission on Enterprise, Business Facilitation and Development. At that session, the Commission noted that globalization and the post-Uruguay Round environment had brought with them a new competitive environment and hence new requirements for sustained competitiveness on the part of firms. The Commission therefore called upon the UNCTAD secretariat to organize a further expert meeting to discuss the development of sustainable local services, including financial and non-financial services, and human resource development, to improve and promote the capacity of SMEs in developing countries, and to prepare a study on innovative non-fiscal measures for upgrading SME clusters.

5. The provisional agenda for the fourth session, approved by the Commission at its third session, includes an assessment of policies and non-fiscal measures for upgrading SME clusters (agenda item 3). This report has been prepared by the UNCTAD secretariat in order to facilitate consideration of this item.

II. OVERVIEW

6. As a consequence of globalization, the requirements for development have changed. Competitiveness is increasingly dependent on the ability of firms to use and develop new technology effectively. New core technologies such as microelectronics and biotechnology that have applications across a wide range of sectors have emerged. Moreover, these technologies reinforce one another, and a number of sectors and industries are affected by more than one of the new technologies. In view of their wide-ranging applications, access to these new technologies is increasingly becoming crucial to international competitiveness (Kumar and Siddharthan, 1997).

7. The new innovation-based mode of competition rapidly renders obsolete the technological capacity built up by firms and calls for a continuous process of upgrading. Failure to do so leads to a loss in market share and profitability. Governments are consequently being urged to adopt innovation policies that are focused on enhancing domestic technological capabilities as the most effective way to enable firms to continuously upgrade and achieve and sustain global competitiveness.

8. Technological capabilities can be described as information and skills - technical, organizational and institutional - that allow productive enterprises to utilize equipment and information efficiently (Lall, 1994). Know-how capabilities are often referred to as production and process capabilities (see box 1). Experience shows that the process of upgrading and technological capability development takes time and can involve considerable costs to the firm.

9. Upgrading and technological capability development vary according to the level of a country's development. In most developing countries, technological capability development will largely mean becoming more efficient and competitive through the use of imported technologies. Some ability to modify the design or materials used in order to solve problems that arise from a variation in product or the processing environment will be required. In the least developed countries, technological capability development will comprise the mastery of simpler and well diffused technologies - largely assembly operations. In the more advanced developing countries, technological capability building will involve the mastery of complex scale and skill-intensive technologies with a greater emphasis on science-based R&D and design capabilities. Broadly, technological capability can be seen to have three main components: absorption, adaptation and creation.

10. It is now well established that technology is more than just technical hardware. It involves the interlinkage of a range of activities such as the development of a company strategy and the technological

development of personnel. In order to attain and maintain competitiveness firms must possess relevant economic knowledge or capabilities (see box 1). Some of these capabilities can be acquired 'ready made' from the market. For example, any enterprise using a new technology can accumulate some know-how as an automatic result of the production process. Such learning is, however, insufficient to ensure survival as more complex technology is encountered or if market conditions become more demanding. The acquisition of know-what, know-why and know-who requires a concerted effort and investment on the part of the firm itself and demands a certain level of competence from its employees. In other words, upgrading goes beyond choosing and adopting technologies from industrial countries and includes the accumulation of domestic assets which embrace technological competencies and capabilities, organizational capabilities and the management of links between different types of actors or institutions that are important in this process (UNCTAD, 1998a).

11. Firm-level technological development depends on external factors such as interaction with the local economic environment, which provides the human and financial resources needed for the cultivation of internal capability and essential services such as standard setting, testing, basic R&D and other forms of institutional support that enable firms to conduct in-house technical work effectively. Thus, technological upgrading and capability development has to be dovetailed with improvements in education and training systems, as well as with the provision of technology support and financing.

12. Technology is concentrated in the more advanced economies of the world and access to technology and the transfer of technology are extremely important issues for the growth and development of developing countries and LDCs.

13. The transfer of technology occurs in various ways. Direct purchases of equipment are the most obvious. Direct purchases often come with technical aid (installation and service) from manufacturers and can be a source of technological learning, although limited. Accompanying manuals and blueprints can be the source of capability development, especially if firms go a step further to undertake reverse or imitative engineering. Other sources of technology transfer such as licensing, foreign direct investment (FDI) leading to joint ventures, original equipment manufacturing (OEM) and other subcontracting arrangements serve a dual purpose, providing rapid access to technology as well as access to global markets.

14. Licensing and subcontracting arrangements tend to result in greater and in some cases more complex technology transfers because it is in the interests of the subcontracting transnational corporation (TNC) to ensure quality, price and delivery according to the precise specifications of the product in order to safeguard its brand name. In a very few instances, OEM has fostered own design manufacturing (ODM). Under ODM, the local firm carries out some or all of the product design and process tasks according to a general design layout from the TNC.

Box 1

A matrix of technological capabilities

	Public agencies Producer assns.	Producing unit	Educational/R & D institutions
	Acquisition 'know-what'	Utilization 'know-how'	Absorption 'know-why'	Innovation 'know-who'
Product-related technological capabilities	evaluate and asesss alternatives	quality control/ standardi-zation	improvements in productivity attention to maintenance	introduction of variety improvements in quality reduction in costs new combinations of generic technologies
Process-related technological capabilities	scan, choose and access suppliers depackage imported technology	problem identifi-cation source & procure spare parts and other inputs linkages to clients and equipment suppliers	problem solving, innovation modify existing plant and equipment linkages to productivity centres and to suppliers	in-house process engineering to reproduce and redesign existing processes and create new ones linkages to indigenous and external engineering consultancy services and technology institutes
Organizational technologies	selection and acquisition skills, e.g. bargaining, ability to arrange financing & prepare feasibility studies	organize and carry out maintenance routines, training activities & day-to-day production activities	strategic planning capabilities marketing, engineering, and testing skills	skill in managing a portfolio of partnerships in-house R & D capabilities ability to change decision routines & alter the organisation of production

Adapted from UNCTAD (1990).

ODM offers the local firm a mechanism to capture more of the design value-added without having to invest in marketing and distribution networks. ODM represents an advance in technological competence on the part of the local firm. Thus, subcontracting arrangements can be a first step up the ladder of technological mastery.

15. Subcontracting arrangements such as the ones described may, however, delay the emergence of in-house R&D. They can also be a means to maintain competitiveness through low-wage production. Mytelka (1978 and 1998) and Dodgson (1998) point out that over-reliance on subcontracting arrangements by the newly industrializing economies (NIEs) of Asia led to an underdevelopment of technological capabilities which is revealed by a lack of capacity to develop, produce and market technological innovations by NIEs, including the more successful ones among them, namely the Republic of Korea and Taiwan, Province of China.

16. The process of catching up and keeping up technologically will be extremely costly and risky for developing countries. Given the rate at which changes occur and the capital-intensity of some new technologies, some commentators caution Governments against rushing to launch big national catch-up efforts because by the time there would be anything to show for their efforts, the world would have moved on (*The Economist*, 1999). Others advise venturing into technologies with affordable R&D intensities such as biotechnology and energy technologies (Anandakrishan, 1998).

17. Apart from its R&D affordability, biotechnology appears to have other attractions for developing countries. Current barriers to entry into the biotechnology field are relatively low (Fransman, 1994). Certain skills, capabilities and infrastructure are already available in developing countries and could be upgraded with little effort, and a rich genetic heritage is also present (Kumar and Siddharthan, 1997). Obvious entry points are in agriculture and agri-processing, in which most developing countries are largely engaged. Moreover, biotechnology feeds into the development of new materials, and new materials have important synergies with microelectronics. It should be noted, however, that the TRIPs agreement may mean diminished access to genetic materials used as inputs to research in developing countries in the years to come (UNCTAD, 1999a).

18. Although the target of effective innovation policies is the individual firm, these policies are most effective when directed at networks or clusters of firms. Informal contact with other firms is an important mechanism for the transmission of tacit knowledge that is not easily transferable and has to be taught and learned. New production knowledge or knowledge of best practices can often be transmitted in this manner. Clustered firms can thus enhance technological capability through specialization, tacit knowledge flows and cross-organizational learning. They can share the costs of technological upgrading and innovation and reap other economies of scale by functioning as a group rather than on an individual basis. In addition, cluster-based interventions yield efficiency gains and cost

reductions because of the possibility of pooling business services and channeling limited resources into activities that can maximize returns. Consequently, clusters permit focused interventions whose benefits can be diffused rapidly and can have a powerful demonstration effect in the local economy. SME clusters and networks are widely considered to be one of the most cost-effective ways of delivering technical assistance to SMEs to upgrade technology, management and marketing strategies (UNCTAD, 1998b).

III. CONTEXTUAL FACTORS THAT INFLUENCE UPGRADING

19. In both developed and developing countries, there is compelling evidence that clustering helps SMEs to compete effectively in the global economy. Not all clusters, however, grow to become world competitors. Some clusters, or firms located within clusters, grow while others stagnate or regress. Such clusters typically pursue the 'low road' to competitiveness and engage in short-term cost-cutting exercises and cut-throat low-wage, low-quality measures in response to competitive pressures. In contrast, successful clusters pursue the 'high road', which promotes increased productivity, innovation and good labour standards, thus ensuring economic growth that is accompanied by higher standards of living and is sustainable.

20. The process of upgrading and technological capability development will not be the same for all countries. Much will depend on context and country-specific factors that may exert an important influence on the ease, cost and time that the upgrading process will take. Thus, policies for upgrading clusters will have to be geared towards the technological endowments of a country. In addition, there is no predictable learning curve which all firms travel. This renders the outcome of the upgrading process uncertain. In most developing countries, where the culture of learning is weak, this uncertainty is made worse by the likelihood that the learning process itself may have to be learned.

21. In order to induce learning in the economy, policy-makers have to put in place policies that exert pressure for change and policies that affect the capability to impose and absorb change. The first set of policies constitutes the incentive framework that gives rise to the demand for local technological effort. Such a framework calls for an enabling environment that includes policies to engender competition in the domestic market. Attention must, however, be paid to the choice of such policies, their timing and sequencing. The second set of policies calls for the development of technological infrastructure which includes human resource development, universities, research institutions, quality assurance centres and all other policies and institutions which provide sources of and access to knowledge and which motivate partnering and collaboration for technological development. This set of policies requires policy actions at the meso and micro levels, as well as co-operation between the public and the private sector.

A. Policy Considerations

22 Policy choices by Governments play a pivotal role in shaping and stimulating the development of technological capability. The development of innovation capabilities appears to have been most successful in those economies that have followed an outward-oriented strategy. One reason is that competition is considered to be the most potent stimulus for technological effort, and export orientation has proved more effective in creating the competitive market conditions that are important for stimulating the demand for technological learning. A second reason is that surveys of SMEs show that feedback from clients and suppliers are the two most prominent sources of new information and provide a powerful incentive to innovate. As a result, entrepreneurs need to be trained to be receptive to such feedback and indeed should seek it out.

23. However, outward orientation by itself has not proved a sufficient condition for generating technological capability or innovation. For instance, Hong Kong adopted a *laissez faire* approach to its development and focused on providing a stable administrative and macroeconomic regime. As a result, Hong Kong developed a light, specialized and efficient manufacturing base which, nonetheless, lacks technological depth and is therefore vulnerable to rising labour costs. Consequently, wage pressures forced many of Hong Kong's manufacturers to relocate to other countries, starting a trend of deindustrialization.

24. A stable macroeconomic environment permits firms to plan and develop a growth strategy. This is particularly true when it comes to making investments that require a medium or long-term horizon. Innovation is critically dependent on access to technology, and trade policies should not discourage its importation. In addition, the existence and enforcement of intellectual property regulation and adherence to the Agreement on Trade Related Investment Measures (TRIMs) is increasingly important in attracting FDI and facilitating access to and the transfer of foreign technologies.

25. No conclusive evidence exists on the benefits and costs of intellectual property protection established by the Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPs Agreement) and administered by the World Trade Organization. Such protection is unlikely by itself to lead to any general increase in the rate and level of innovation. However, there are fears that it may have negative effects in-so-far as public research institutes may be inclined to protect their research results and grant exclusive rights of exploitation to a private enterprise. It is not clear either what its impact is likely to be on the transfer of technology. It is likely to pre-empt reverse engineering and similar avenues of capability development which have been an important source of capability development for countries and territories such as the Republic of Korea and Taiwan, Province of China. Certainly, the cost of obtaining protected technology will be higher and beyond the means of most developing country SMEs. Moreover, the evidence indicates that, since the 1970s, access to technological and scientific knowledge

held in advanced nations has become more difficult for developing countries and that higher levels of protection may reinforce this trend (South Centre, 1997). While measures to prevent the abuse of technology rights or practices which impede the transfer and dissemination of technology are quite common in developed countries, there is a lack of legislative measures in this regard in many developing countries where the occurrence of these practices has been observed.

26. The TRIMs Agreement obliges developing country members of the WTO to phase out all trade-related performance requirements imposed on enterprises, such as local content regulations and export obligations. The objective of the TRIMs Agreement is to establish rights of entry and prohibit favourable treatment for national over foreign firms. However, the Agreement tends to diminish the ability of developing country Governments to direct FDI according to their developmental goals (Kumar and Siddharthan, 1997).

27. TNCs control a major share of technology-intensive industries and access to new technologies. Foreign direct investment is acknowledged to be a potentially powerful instrument for improving access to international markets and for obtaining technological and organizational capabilities and thus enhancing the international competitiveness of the host developing country (Chudnovsky and López, 1999). This would seem to suggest that Governments may follow one of two paths to development, the first encompassing a vision of a free trade economy with heavy reliance on foreign investment and foreign technology, and the other centring on a vision of a deep and diverse industrial sector with predominantly nationally owned enterprises capable of autonomous innovation. The question for many developing countries embarking on a process of upgrading and technological capability development is which of these paths is the most effective.

28. Singapore is perhaps the most celebrated case of technological upgrading via FDI and has achieved impressive export-led growth rates, ranking as the world's most competitive economy in 1995. By directing FDI inflows into higher value-added, high-tech activities, Singapore rapidly evolved from assembly based on cheap labour to advanced automated manufacturing. There were, however, no interventions in relation to technology transfer in Singapore. Thus, although Singapore has been very successful in building up indigenous production, it has the weakest indigenous entrepreneurial and technological base of the East Asian NIEs (Lall and Kell, 1991). Singapore's product range is narrow and its technology is almost entirely provided from abroad.

29. The experience of Singapore clearly shows that a reliance on FDI can reduce some of the learning requirements for developing countries and that an economy can make significant advances if it carefully selects and guides FDI inflows. However, it also suggests that achieving a more widespread diffusion of TNCs' technologies and creating interlinkages with local firms requires specific

interventions to promote local capability development.[1] Evidently, the potential benefits from FDI cannot be taken for granted.

30. Technology imports are undisputedly a necessary input to local capability development for any developing country. However, an important lesson to be learnt is that the mode of technology import has an important effect on the extent and nature of local capability development. Internalized modes such as FDI tend to centralize the process of innovation in the home country, whereas externalized modes such as licensing, equipment purchase, arms length contracts, etc., are inclined to lead to more technological learning and a better understanding of the technology transferred. Even then, the effective transfer and mastery of the technology will hinge on prior investments in technical and managerial capabilities, i.e. absorptive capacity.

31. In general, the evidence indicates that in countries that are technologically weak, the extent of technology transfer by TNCs is correspondingly weak. In these cases, TNC subcontracting of local firms is confined to relatively simple components, with little transfer of technology apart from assistance with quality control techniques and minor adaptations. Joint venture arrangements also tend to be in low-technology, low value-adding manufacturing. Where the technological and absorptive capacity of the local firm has been high, experience shows that some transfers of product and process technologies of high precision and good quality to local subcontractors have occurred. Technology transfers by TNCs have rarely extended to high value-added and technologically demanding tasks such as design and development. Hence, a reliance on policies which encourage FDI from TNCs is more likely to lead to technological upgrading in terms of facilities and equipment but is unlikely to build innovation capabilities (Dodgson, 1998).

32. It should be stressed that process and production technologies are easily replicable and cannot provide the basis for longer-term, sustainable competitive advantage at a global level.

B. Technological infrastructure

33. The ability to absorb technology, to deploy it efficiently and to create it depends not only on the internal decisions of firms and on level of competence, but also on the level and quality of the country's technological infrastructure. The drive towards upgrading and developing technological capability will be influenced by the availability of people capable of understanding, absorbing, adapting, and ultimately developing new technologies. It will also depend on the availability of supporting technological infrastructure and finance for technological activity. Governments will need to pay attention to reforms at the meso- and micro economic levels in order to improve the overall competitiveness of SMEs and

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[1] See UNCTAD (1998c).

their clusters. Mesoeconomic policies particularly need to target the institutional infrastructure necessary to support SME development and promote inter-firm co-operation and collective efficiency.

34. Education, particularly at secondary and higher levels, creates the tacit knowledge that is necessary to assimilate foreign and complex technology and acquire the necessary know-why in order to adapt and develop new technologies independently (Kim, 1997). High levels of absorptive capacity minimize the costs of foreign technology transfers and maximize technological learning because the assimilation of know-how is easier and faster. In many developing countries, low levels of technological accumulation point to a need for an overhaul of the educational system in order to incorporate basic technical and business education which will serve as a basis for either on-the-job training by firms or formal industry-wide education. It also points to a need to train science and technology professionals. According to Dodgson (1998), the lack of science and technology professionals translates into a weakness in many East Asian firms' abilities to manage innovation. Much of the technological strength of East Asian companies lies in production and project execution. As a result, too many East Asian firms are vulnerable to rising labour costs and the flight of their industries to lower wage cost locations.

35. In a number of cases the overhauling of the education system may have to include expanding English instruction, as is the case in Costa Rica where the campaign to transform the country through high technology has included an aggressive strategy to expand English instruction.[2]

36. Continuous upgrading requires continuous investments and improvements in the quality and quantity of education. A small educated elite is not sufficient for sustained competitiveness and can be a limiting factor in attracting complementary FDI. For instance, Costa Rica risks losing its competitive advantage before it even gets to enjoy it because it simply does not have enough skilled human resources of the type required by the 25 high technology foreign firms it has been able to attract since 1995. Competition for skilled labour among these companies is becoming intense, and there are concerns that it will result in wage inflation which could compromise profitability (Quinones, 1998).

37. Technological upgrading more often than not requires a corresponding upgrading in physical infrastructure. For example, the move to automated high-tech modes of production and the use of IT presupposes reliable supplies of electricity. Establishing and maintaining contact with customers and suppliers and receiving, processing and effecting the delivery of orders at minimum cost require an efficient telecommunications and transport system. The efficiency of its transportation and communications infrastructure made Singapore an attractive location for foreign firms. TNCs were able to expand operations and advance production to more complex products as a result of Singapore's

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[2] Costa Rica chose to upgrade and develop technological capability by targeting American FDI, hence the need for proficiency in English.

continuous improvements in educational quality and the capacity and efficiency of the transportation and telecommunications infrastructure (Hobday, 1994).

38. Many developing countries, and particularly LDCs, face a growing danger of marginalization because they lack the skills and infrastructure to reap the potential benefits from emerging information technologies (IT). Many manufactured products and commodities are not well suited for direct sale through the Internet (UNCTAD, 1998d). However, preliminary evidence shows that E-mail is the primary benefit of the Internet to developing countries, although its use is not as pervasive as in developed countries (Daly and Miller, 1998). Internet access remains scarce and expensive in developing countries, and unless current cost structures are improved, those countries' participation in electronic commerce will remain limited (UNCTAD, 1998e). The immediate and real potential for IT in developing countries lies in developing competence in using it across a whole range of economic activities in order to build organizational competencies that enable firms to operate more efficiently, keep up with competitors and provide distinctive value to customers (Lall and Wignaraja, 1998). Forward-looking Governments should gear up to provide both the physical infrastructure and the skills needed for information technology.

39. The ultimate goal of technological capability building is innovation. Innovation presupposes well developed local design and innovation capabilities that call for intense R&D activity by firms. A firm attains the highest level of technological capability when it acquires the ability to develop products based on knowledge acquired through its own R&D efforts. Without R&D, the firm's ability to adapt foreign technology and eventually develop its own new technologies will be severely constrained. In an innovation-based global economy, changes in the knowledge base are frequent and generate a need to tightly couple scientific knowledge and production (Aharoni and Hirsch, 1993). As a result, linkages between knowledge-creating institutions such as universities and research and technical institutions has become a critical factor in achieving and maintaining competitiveness.

40. R&D at the level of the firm is typically weak in developing countries. This may not be entirely unexpected given that R&D is considered not to be a priority for most developing countries because they are engaged in the catching up process which comprises mainly the mastery of mature and freely available technologies. However, experience shows that in a liberalized (and presumably competitive) environment and where the undertaking R&D is not a habit, free access to technology imports is unlikely to lead to pressures to invest in R&D - even when firms are upgrading their operational capabilities (Najmabadi and Lall, 1995). For instance, with the advent of trade liberalization, Tanzanian industries are reported to have has lost interest in local R&D, preferring to import proven technologies from abroad (Wangwe and Diyamett, 1998). This is an indication that it cannot be assumed that trade liberalization and export orientation will induce firms to invest in R&D. Another reason not to ignore R&D in developing countries is that imported technology often requires adaptation to local conditions, and the

adaptation and improvement of foreign technologies needs local R&D effort. Specific interventions are therefore necessary to promote a culture of R&D and maximize the complementarity between technology imports and local R&D efforts.

41. Many developing countries have established public sector institutions that specialize in science and technology activities. However, these institutions are typically underfunded and their research activities are not targeted at any specific group of enterprises and are generally not driven by the needs of the enterprises they purport to serve. The results of their research often cannot be easily commercialized and remain largely unknown to the enterprise sector. In spite of these problems, Governments still have a major role to play in subsidizing R&D activities. R&D is costly and time consuming, and SMEs simply do not have the specialized human or financial resources to carry it out. Thus, significant public participation in the provision of R&D is necessary in order to offset the inherent disadvantages of small size, which prevent SMEs from engaging in R&D.[3]

42. Most strategic technology partnerships or alliances do not involve developing countries. However, technology alliances involving developing country firms have been increasing in recent years. The RPI database[4] registered 30 technology alliances formed by TNCs in developing Asia, accounting for 10.5 per cent of the total R&D activities of TNCs in developing Asia (Reddy, 1999). Notwithstanding this, it would appear that the forms of partnering in developing countries that will involve SMEs in any significant numbers are those involving linkages between firms and parts of the technological infrastructure, especially universities, research institutes and technology agencies (James, 1994). Upgrading SME clusters in developing countries will necessarily entail a reorientation of public R&D institutions to link their activities to their intended users and ensure a demand-driven focus to their work.

43. An important element of technology infrastructure is quality assurance institutions and the support available to firms for quality management. Meeting ISO 9000 quality management standards is increasingly becoming a prerequisite for international trade and integration into the global economy. The spread of ISO 9000 accredited quality management systems has not yet reached significant levels in LDCs and most developing countries. Few SMEs in developing countries engage in systematic quality control or have routine equipment maintenance capabilities. Fewer still are able to meet the costs of obtaining ISO certification and maintaining it, and this is a major deterrent for most SMEs from aiming

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[3] Kim (1997) suggests that the size disadvantages of SMEs in R&D, coupled with the advantages that larger firms have in investing in their own R&D, mitigate in favour of achieving a balance between the number of small firms and larger firms in an economy, or introducing a large firm which could assume the role of the leader to an SME cluster. He suggests that the economy of the Republic of Korea could benefit from an injection of flexibility that comes from having more SMEs. On the other hand, Taiwan, Province of China could profit from having more large enterprises capable of financing and engaging in their own R&D.

[4] This database on strategic R&D activities of TNCs outside the industrialized world has been developed by Prasada Reddy at the Research Policy Institute, Lund University, Sweden.

to obtain certification. Government assistance will be necessary to assist SMEs meet the expense involved in getting ISO 9000 certification. Technologically dynamic buyer-seller relationships involving clusters and their foreign buyers can be instrumental in improving quality control and obtaining ISO certification. Co-operation between the public and private sector was instrumental in bringing the Pakistani surgical instrument cluster up to international standards and developing the necessary specialized support services and institutions for its SMEs (UNCTAD, 1998b).

IV. UPGRADING SME CLUSTERS

44. The evidence indicates that various interventions can help upgrade and enhance the competitiveness of SME clusters. The following is a review of selected case studies of effective interventions aimed at technological upgrading and capability development. The case studies cover a range of measures that includes skills enhancement through training and the provision of technological and R&D support to SMEs.

A. Skills enhancement

45. A significant part of skills enhancement comes from training in the course of employment. In a world of rapidly changing technologies and new organizational methods, it is essential for industrial firms themselves to invest in training their employees. A World Bank study of enterprise training found that firm-level training has a significant and positive effect on the productivity of all types of firms.[5]

46. Singapore is a regional leader in employee training programmes held outside the firm. Experience shows that high technology industries obtain larger productivity gains from training than low technology industries. Accordingly, Singapore's strategy to upgrade was based on creating and enhancing specific high technology skills at post-employment level (see box 2).

47. Experience also shows that training skilled workers yields more productivity improvement than training unskilled workers. Singapore's focus on apprenticeship training for pre-workers offsets the disadvantages of training unskilled labour while ensuring the availability of a pool of appropriately skilled labour to facilitate the expansion of existing industries and the establishment of new ones. TNCs often cited the availability of low-cost engineers, technicians and skilled workers as a primary reason for locating in Singapore (Hobday, 1994).

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[5] Quoted in Lall and Wignaraja (1998), the study examined the effects and determinants of training in several developing countries in Asia and Latin America.

48. By 1990 more than 3,000 TNCs (including 600 large firms) from Europe, Japan and the United States had established operations in Singapore (Hobday,1994). As firms developed, the Government made improvements to infrastructure and the supply of engineers and technicians. Institutes for software training, electronics engineering, advanced mechanical engineering and research were set up as part of the Government's policy to encourage TNCs to extend their value-added activities such as design and R&D and make Singapore their headquarters for R&D. The advisory boards of the institutes include managers of TNCs who advise on specific projects and overall direction in line with the Economic Development Board's policy of public-private sector co-operation.[6]

Box 2

Singapore's training system

In order to promote the manufacturing sector, the Government of Singapore established policies for education, training and skills development. Unusually, the Government collaborated with TNCs to jointly set up these centres and develop apprenticeship schemes under which employees receive salaries while they are undergoing training in state-of-the-art, complex manufacturing technologies. The Economic Development Board (EDB) also worked jointly with foreign Governments to provide technical training.

For example, the Vocational and Industrial Training Board (VITB) offers a range of courses, including broad-based pre-employment full-time skills training for school leavers and part-time skills courses for workers. It also offers customized courses based on requests from companies.

VITB offers apprenticeship training to school leavers and ex national servicemen consisting of on-the-job training under the supervision of experienced and qualified personnel from participating industries as well as theoretical lessons conducted at VITB training institutes or industry/company training centres. VITB also provides, in collaboration with industry, testing and certification of its trainees and apprentices, as well as trade tests for public candidates.

By 1991, the National University of Singapore, Nanyang Technological University, polytechnics and the institutes together trained around 22, 000 engineers and craftsmen per annum.

Extracted from various sources.

49. SMEs in developing countries generally neglect training, apart from informal on-the-job instruction that consists of watching and imitating experienced workers. SMEs usually eschew investing

[6] For a discussion on the respective roles of the public and private sector and their interaction for SME development see UNCTAD (1997).

in their employees because of the difficulties they perceive in appropriating the benefits of such training. More importantly, they lack the financial resources to do so.

50. Capability development is a costly process. Tax incentives for training mainly benefit large firms. SMEs also face greater market failures in terms of information, access to credit and access to technology support services as compared to larger firms. Successful economies, both developing and developed, have put in place schemes to meet the special needs of their SMEs in respect of information, skills, finance, management training, market information and technology support.

51. In order to achieve upgrading of SME clusters, it will be critical to convince SMEs of the importance of training and provide training and credit packages in addition to other technical and marketing support.

B. Financing skills development

52. Box 3 describes some of the measures which different countries have put in place in order to help SMEs meet the costs of training their workers. In a world of rapidly changing technologies and new organizational methods, it is essential for firms themselves to invest continuously in training their workers.

53. In countries like Japan, training exceeds the Governments's entire education budget. In the United States, firms spend around 7 per cent of sales on training (Lall and Wignaraja, 1998).

54. In many developing countries,it may be necessary first to establish the relevant training institutions. It is important to note that private training institutes are more responsive and effective than public institutions. Wherever possible, such training should be provided in cooperation with the private sector. For example, it is normal in the Republic of Korea and Singapore for industrialists to participate in the development of the curriculum for technical training.

Box 3

Financing training

Another instrument of training policy in **Singapore** is the Skills Development Fund (SDF), set up to provide training grants to SMEs of between 30 and 90per cent of total costs. During the early 1980s, the SDF was financed by a levy on employers of around 4 per cent of workers' wages, matched by government contributions. Since 1992, the SDF has been funded by a levy of around 1 per cent on wages of less than S$170 per month.

The Training Voucher Scheme supports employers in respect of training fees. In 1990 this scheme benefited 3, 000 new companies, many of which had 50 or fewer employees. The Training Leave Scheme encourages companies to send their

employees for training during working hours. It provides 100 per cent funding for training in approved programmes. In 1990, over 5, 000 workers benefited from this particular scheme.

The success of the SDF is due in part to its strategy of incremental implementation. Initially, efforts focused on creating awareness among employers, with ad hoc reimbursement of courses. The policy was then refined to target in-plant training, and reimbursement increased to 90 per cent of costs. Further modifications were subsequently made to encourage the development of corporate training programmes by paying grants up-front, thus reducing interest costs to firms.

Since the 1970s, the Republic of **Korea** has imposed a 5 per cent payroll levy for training on medium and large firms. In **Malaysia**, the payroll levy for training is 1 per cent.

Since 1989, **Mauritius** has also put a training promotion scheme in place. The Scheme is administered by the Industrial and Vocational Training Board (IVTB). A 1 per cent levy on basic salaries is used to provide incentive grants to firms for training on a cost-sharing basis. The size of the grant is related to the costs of training and not the amount contributed to the levy fund. The IVTB scheme applies to approved in-house training programmes as well as training in institutions registered with IVTB, and includes overseas courses.

Extracted from Lall and Wignaraja (1998) and Hobday (1994).

C. Promoting capability development by SMEs

55. Box 4 describes some of the ways in which Taiwan, Province of China helps its large number of SMEs. The Taiwan case is perhaps the most interesting because of the central role played by SMEs in the industrial and export growth of that economy. Taiwan, Province of China is considered to have the most effective technology extension and contract research service in the developing world, which has allowed it to exploit the inherent flexibility of SMEs to meet changing demand conditions and develop market niches. Taiwan, Province of China has been able to achieve rates of export growth nearly as high as those of the Republic of Korea.

Box 4

Support for SMEs in Taiwan, Province of China

Taiwan, Province of China has around 700, 000 SMEs that account for 70 per cent of employment, 55 per cent of GNP and 62 per cent of manufactured exports. An impressive set of programmes has been put in place to support them.

Government-supported technological and scientific research institutes have been indispensable in the territory's high technology industrial development. The government has spent extensively on R&D and has a succession of programmes designed to encourage indigenous technological capabilities in strategic technologies.

Management and technology assistance is provided by the China Productivity Centre (CPC), the Industrial Technology Research Institute (ITRI) and a number of industrial technology institutes covering the metal, textile,

biotechnology, food and information industries. These institutes provide a range of services including training, quality systems, technology development, and the acquisition of foreign technology.

The CPC is well known for its efforts to promote automation to cope with rising wages and needs in respect of precision and quality. The CPC sends teams of engineers throughout the country to demonstrate to enterprises the best means of automation and solve relevant technical problems by carrying out research projects or linking enterprises to research centres to solve more complex technical problems. The government encourages private industry to contract research to universities. Such contracts are funded through research grants with enterprises providing matching funds.

ITRI was established to undertake R&D considered too risky for the private sector and has played a major role in developing local technological capabilities in firms. Through the Open Laboratory Programme, ITRI provides space and facilities for joint R&D between ITRI researchers and local business. It also has space for business incubation and training facilities. The government subsidises 60 per cent of the cost of total consultancy services for firms.

Other measures related to promoting SME networks and clusters and their upgrading include the Centre Satellite Factory Programme of the Ministry of Economic Affairs. The programme integrates smaller factories around a principal one involving vendor assistance and productivity raising efforts as well as a rational sharing of tasks between participating enterprises. By 1989, 60 networks with 1, 186 satellite factories were in operation, mainly in electronics. In 1980, the government also set up a science park in Hsinchu with 13, 000 researchers in two universities, six national laboratories (including ITRI) and technology institutes. The Park offers a wide range of tax incentives, low interest loans, R&D and manpower training grants, and duty-free importing of equipment and materials. In 1995 it had 170 companies specializing in electronics. Initially the government invested directly in small start-ups, but increasingly private venture capital companies are assuming this role. The Park has proved successful in attracting returned expatriates. Park companies are successful technologically and have entered into international strategic alliances.

Extracted from. Lall and Wignaraja (1998). and Dodgson (1998).

56. Fostering firms of a size able to launch independent R&D and clustering smaller firms around them in order to create synergies and co-operation as Taiwan, Province of China is attempting to do through its Centre Satellite Factory Programme is one option. Providing incentives for TNCs to increase R&D activity is another option.

V. IMPLICATIONS FOR POLICY

57. The main challenge to policy-makers in developing countries is to help SME clusters to follow the 'high road' by creating an environment that stimulates and supports learning, innovation and constant upgrading.

58. Technological upgrading and capability development cannot be achieved without the development of crucial institutions, laws and organizational structures. In addition, it will be difficult to initiate low-cost technological upgrading in economies where physical infrastructure and

telecommunications are inadequate and inefficient. Accordingly, policy must ensure the availability of both physical and human capital, as well as vital technological infrastructure. Knowledge-creating institutions such as universities, research institutions and technical agencies play a vital role in stimulating and facilitating technological capability development and innovation. Policies must promote beneficial interlinkages between such institutions and SMEs. Building and strengthening interlinkages between these knowledge-creating institutions and their counterparts in the North would also facilitate knowledge creation in the South and enhance the positive impacts of globalization.

59. In some developing countries, what may be initially required to promote competitiveness and efficiency are improved skills and an efficient technology infrastructure (for standards, metrology, quality assurance, etc.) before elaborate R&D facilities are created (Najmabadi and Lall, 1995).

60. Policies such as those to improve the level, quality and quantity of education and educational output and R&D have too long a gestation period to have a quick impact. In the short term, efforts will have to focus on increasing the production and process capabilities of existing enterprises. For example, mechanisms will be necessary to compensate for absent domestic skills. Hiring expatriate managers where local staff do not possess the necessary technological information is one way in which firms can substitute for skills not available on the local market. However, the policy environment must be conducive to such mechanisms being employed by local firms while at the same time ensuring that skill gaps in the domestic market are being eliminated.

61. Demand-side interventions such as outward orientation and trade liberalization have proved not to be sufficient conditions to stimulate investment by firms in technological capability development. Specific supply-side interventions aimed at strengthening the technological infrastructure to enable firms to develop capabilities will also be required. Policies for both the demand and supply of local technological effort are mutually reinforcing, and it is unlikely that one will work without the other. A phased approach to liberalization is preferable to shock treatment. The pace and exposure to international competition should be based on a realistic assessment of the learning or relearning needs of activities which are potentially viable. Liberalization should not be so sudden as to abort technological effort by domestic firms.

62. Since innovation policies are most effective when directed at networks or clusters of firms, policies to promote successful inter-firm cooperation will also contribute to the development of local technological capabilities.

63. Clusters and dynamic local economies are the development counterparts of the globalization process. Experience shows that strictly top-down interventions aimed at solving problems at the micro level can easily fail. This means that while macro policies are needed (such as promoting open markets, streamlining import and export regimes and protecting property rights), measures to stimulate upgrading

and the development of technological capabilities will need to be formulated and also implemented at the local and regional level. They will need to involve the private sector as both a development partner and the intended target of the interventions. Since cluster upgrading is highly context-specific, a progressive shift towards decentralized, flexible, bottom-up, tailor-made policies has to occur. Interventions at the meso level thus represent the most appropriate level at which to launch and monitor the process of upgrading and technological capability development. The importance of meso-level institutions such as universities and research bodies, business development service providers, business associations, etc., cannot be overstated.

64. The process of technological upgrading and capability development is dependent on contextual factors. SME clusters in developing countries and in LDCs are at a particular disadvantage because the environment within which they operate is not always conducive to enterprise development. Vital business services and other forms of institutional support are often absent or inadequate. Changes in international rules of trade are also exposing developing country SMEs to stringent competitive conditions that require them to expend much more effort in order to remain viable. The process of upgrading will be that much harder, slower and more costly for SMEs in developing countries because of it.

65. FDI can be a powerful instrument for technological upgrading. Careful targeting of FDI to clusters and industries that are potentially competitive can complement and enhance local capabilities. FDI has not, however, proved as effective in the development of technological capability and cannot substitute for local technological effort. There is therefore no real choice between technological capability development via FDI and capability development by other methods. For example, until recently, Singapore's innovation policy was one-dimensional, focused on attracting TNCs and then providing incentives for them to undertake R&D and design products locally. Policy has now altered to focus on the active encouragement of local technological capabilities. EDB has established the Local Industry Upgrading Programme to facilitate technology transfer (see box 2).

66. The technological benefits from FDI can only be accessed and maximized by firms that have the absorptive capacity to do so. Policy interventions are needed to enhance the absorptive capacity of local firms and to assist local firms not only to absorb the technology which the foreign investor chooses to bring but also to negotiate for technology that they want. Subcontracting is facilitated and encouraged by low transaction costs and the efficiency of potential suppliers. At current levels of education and skill, the transaction costs of extensive subcontracting of the kind which yields superior levels of technology transfer are likely to be very high in developing countries. Specific interventions aimed at making local firms 'ready' for subcontracting and partnerships will have to be put in place.[7] Institutions such as

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[7] See UNCTAD (1998c).

universities, research institutes and technical support agencies can play a vital intermediary role in strengthening the bargaining power of local firms in securing transfer of foreign technologies.

67. The dissemination of technological information is as important as R&D and the development of new technology. Apart from engaging in frontier research and development, universities and other research institutions can play a vital intermediary role in the dissemination and diffusion of information on existing technologies, thus increasing firms' know-what and know-who capabilities. Know-what and know-who capabilities contribute to the acquisition of know-how capabilities. For example, the ability of a firm to substitute for absent domestic skills implies that it possesses certain capabilities related to identifying the relevant sources of required skills quickly and cheaply, as well as knowledge on how to incorporate these skills productively. Business or industry associations can also play an important role in this regard.

68. Financial interventions, such as direct subsidies for R&D and the training of workers, are a critical element of interventions aimed at upgrading or enhancing the technological capabilities of SMEs. Access to finance is a major constraint for all SMEs. Most SMEs have difficulty just purchasing available technology which can significantly improve their productivity. In many developing countries a major part of the upgrading process will include providing SMEs with the necessary access to credit in order to purchase modern equipment.[8]

69. Ensuring a balance between the potentially negative impacts of liberalization on a technologically weak economy, juggling commitments entered into at the global level with the need to develop domestic technological capabilities as fast as possible and at least cost and designing and implementing upgrading and capability development policies and programmes implies learning and competence accumulation on the part of Governments themselves. This means that Governments should focus on acquiring the necessary skills at the local and national levels in order to fulfil this complex task and in order to successfully negotiate improved access to technology at the global level for their domestic firms. It also emphasizes not only the need for policy coherence between and among the various levels of government, but also the need for coherence between policies at the national and international levels.

[8] For issues concerning financial services for SME development and lessons from microfinance see UNCTAD (1999b).

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